Spectroscopy of the heaviest elements

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The anomalously high production cross-section of about 2 microbarn for the cold fusion reaction ^{208}Pb(^{48} Ca,2n)^{254}No was utilized in the in-beam gamma-ray studies of ^{254}No, where the Gammasphere array was combined with the Fragment-Mass-Analyzer (FMA) at Argonne [1] and the Ge clover array (SARI) was combined with the RITU-gas-filled-separator at JYFL in Jyväskylä [2]. By employing the recoil- gating and recoil-decay-tagging (RDT) techniques the yrast line of ^{254}No was identified revealing that the ^{254}No nucleus is deformed with a deformation parameter, b_2=0.27(2).

For further studies of ^{254}No, the SACRED magnetic solenoid electron spectrometer was combined with RITU for in-beam electron RDT measurements. In a careful analysis of resulting prompt recoil-gated electron-electron coincidence spectra of ^{254}No it was found that a broad distribution under the discrete electron lines arising from transitions within the ground state band in ^{254}No is not due to random events but consists of high-multiplicity events, obviously originating from cascades of highly converted M1 transitions within rotational bands built on high K states in ^{254}No [3].

Following the success of the RDT experiments at JYFL, the Jurosphere2 array + RITU system was employed in an in-beam gamma-ray study of ^{252}No for which the production cross-section in the ^{206}Pb(^{48}Ca,2n) reaction is only 300 nanobarn [4]. The yrast rotational band of ^{252}No was observed up to I=20 indicating that ^{252}No is less deformed than ^{254}No and showing evidence for quasiparticle alignment. Both the ^{254}No and ^{252}No data reveal that the fission barrier exists at least up to I ~ 20 in these nuclei.

In order to gain experimental knowledge of single-particle states in heavy nuclei the next in-beam recoil-tagging experiment in Jyväskylä was focused on ^{255}Lr and in Argonne on ^{253}No. They were produced via the ^{209}Bi(^{48}Ca,2n) and ^{207}Pb(^{48}Ca,2n) reactions, with cross-sections of about 300 nanobarn and 500 nanobarn, respectively. Strong X-ray peaks in the resulting spectra indicate that the decay along the yrast line of these nuclei proceeds by strongly converting M1 transitions, which calls for electron-spectroscopic methods.

In the present contribution, the results obtained at Jyväskylä will be discussed in more detail. New data from the on-going RDT campaign at JYFL with the new JuroGam array and the GREAT spectrometer combined with RITU will be shown.

References

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